SEA WORLD: *Tursiops* BREEDING PROGRAM

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Abstract

This report gives an overview of the *Tursiops* breeding program at Sea World. Significant features of this program are: construction of a compatible breeding colony, early hormonal and Doppler detection of pregnancy, and the pre- and post-natal association of inexperienced mothers with experienced females and their calves. In the past five years, there have been 26 *Tursiops* born in breeding groups at Sea World, California and Sea World, Florida. There appears to be a peak in calving activity in the San Diego colony around April and another around October, although calving is not restricted solely to these months. Calving in the Florida colony occurs year round. Females in these programs generally exhibit a two or three year breeding cycle. Projects associated with the breeding program include continued investigation of the hormonal cycles of both breeding females and males, genetic testing to establish paternity and the study of ontogeny of behavior in the calves.

Introduction

Intense interest in the development of productive *Tursiops* breeding programs has been widely expressed by facilities maintaining this and other cetacean species (Ridgway and Benirschke, 1977; Cornell and Asper, 1978; Cornell et al., 1982). At the time of this writing, husbandry efforts in the past five years at Sea World, Inc. have produced 26 *Tursiops* calves. Major contributions to the success of this breeding program are thought to be: 1) the construction of a compatible, relatively undisturbed colony of reproductively active males and including experienced females; 2) early detection of pregnancy by progesterone and Doppler testing; 3) movement of pregnant females to nursery pools where inexperienced females are in close association with experienced females with calves; and 4) maintenance of mothers and calves in a nursery pool situation for approximately a one-year post-natal period with handling of calves kept at a minimum.

General Husbandry

Breeding colonies at Sea World, Florida and Sea World, California are constructed around reproductively active males and experienced females. We stress the distinction between sexually-active and reproductively-active males. It is our experience, as also suggested in Ridgway and Benirschke (1977), that in cases where the sire is positively identified, the reproductively effective males are older, ranging from 15 to over 20 years of age. At the Florida park, the breeding colony consists of one male (tooth-aged at 20 years old, 1982) and five females. These are maintained together all year round. At the San Diego facility, the colony consists of several males with eight females rotating in and out with their calves, as described below, and are maintained with other species in a public participation pool. Neither human nor interspecific interactions appear to influence the breeding success of this group. In establishing both programs, care was taken to construct the breeding colony around known breeding males and females. Once established, efforts are made to minimize disruption of these colonies.

Detection of Pregnancy

Pregnant females are determined by three methods; elevated serum progesterone levels, detection of fetal heart beat by Doppler, and by observation of changes in the physical appearance of the female. The earliest detection is afforded by monitoring changes in serum progesterone levels. This is currently being done by radio-immuno assay (courtesy of V. Kirby, Research Department San Diego Zoo). As a general rule, females exhibiting serum progesterone levels under 1000-2000 pg/ml serum are considered normal; levels above 6000-8000 pg/ml, if they maintain or continue to rise in a month's time, indicate pregnancy. An example of change in serum progesterone with pregnancy is given in Fig. 1 for a female who has had three calves from 1976-1981. Elevated values ranged from 8,000 pg/ml to over 43,000 pg/ml during pregnancy. The earliest noted increase was observed in 5/80, 11 months prior to the birth of her 4/81 calf. Although one might speculate that based on elevated serum progesterone levels by 5/80, gestation was 11-12 months in Tursiops, it is still controversial whether this elevation represents the ovulation prior to pregnancy or the established pregnancy (V. Kirby, pers. comm.). The presence in 3/80 of very low levels of serum progesterone in

this female does, however, limit the gestation period in this species to under 13 months. The continued elevation in months succeeding 5/80 certainly indicates pregnancy by that time.

Pregnant females are monitored by Doppler for fetal heart beat (Medsonics Ultrasound Stethoscope, Model FP3A, Mt. View, CA; Ultrasound Transmission Gel, Aquasonics 100, Parker Lab, Orange, NJ). Fetal heart beat has been discerned as early as eight months prior to birth. Assuming gestation is between 11-13 months in Tursiops, this would indicate detection by the end of the first trimester. A strong fetal heart beat is invariably present six months prior to birth. Female heart rate is approximately 60-70 beat/min., while fetal ranges from 130-150 beats/min.

Pregnancy is also accompanied by changes in the physical appearance of the female. Most notable is swelling of the genital region resulting in a distinct "step-like" appearance in the area of the mammary tissue flanking the genital slit. This is apparent approximately four months prior to birth.

Prenatal Care

When determined to be pregnant, females are left undisturbed; care being taken to keep first-time pregnant females in association with experienced mothers, preferably with calves. In an established breeding program with females cycling at various times, there are usually always female-calf pairs in the breeding colony. The associative learning this provides first-time mothers has tremendously reduced calf mortality due to lack of proper care by inexperienced females.

In the San Diego breeding colony, females near-term are moved to parturition-nursery pools where they are kept with other near-term females and resident mother-calf pairs. Dietary supplements are given at this time. These include vitamin and mineral tablets (Sea-Tab) and hemotenics at increased levels as needed for fetal development (ferrous gluconate, bone meal, etc.). Handling of the females is minimal. Mother-calf pairs remain in these pools until the calf is about one year of age and feeding largely on its own. The female and calf are then returned to the breeding colony.

Birth

Calving has been routine and it has not been necessary to aid any of the

females. In the Florida colony, calving has for the most part occurred during the day. In San Diego, over two-thirds of the calves have been born in the evening or at night. Approaching parturition is signaled by very apparent behavioral changes in the female. Food consumption routinely stops approximately 24 hours prior to birth and abnormal swimming patterns are observed. Hunching and arching of the back, lob-tailing and short, loud, forceful exhalations increase in frequency as the female nears term. The female swims alone, apart from the others, although while calving, females with the tail of the calf protruding have been known to solicit rubbing of the genital area from observers by the pool. Females with the calf's tail visible have also been observed to assume a "head stand" position, with the fluke and tailstock pushed vertically out of the water exposing the genital region. In this position, the female will arch and flex the tail and abdominal area repeatedly. From the first dilation with appearance of tail flukes to full delivery usually takes 30-45 min. The seemingly more difficult deliveries take up to two hours. Parturition of over two hours has been observed in cases of stillbirths. The placenta is delivered within 8-12 hours following birth.

Mothers and newborn calves are observed for 24 hours following parturition noting respirations, nursing activity and checking for any problems which would require medical attention. Calves normally begin nursing within eight hours of birth. Although some have been observed to nurse within an hour of birth, most of the calves start withing 4-6 hours. No auntie behavior has been observed at this stage nor is there any apparent help given by more experienced females. There has been one instance in which a dominant female who had had a stillbirth six months prior, stole a new-born calf from a first-time mother. When this female was removed from the pool, the calf and mother immediately reassociated and the calf was reared successfully by the mother. The female was returned after six weeks and caused no further disruption.

Postnatal Care

On the whole, the mothers and calves in the nursery pools are left undisturbed. We feel that there is an especially critical period from birth to one year of age where it is extremely inadvisable to handle the young calves. Very young calves have been successfully handled, but this is done only if absolutely necessary. Routine observational checks are made to determine the sequence, frequency and duration of nursing, swimming pattern, respiratory rate, calf/calf interactions, calf/adult interactions and adult/adult interactions to ensure that there are no complications. Although a young calf spends the majority of time

with the mother, cooperative nursing has been observed and is apparently well-tolerated. Calves begin trying fish between 3-5 months and by 9-12 months, fish represent a substantial part of their diet. By 18 months, the diet is primarily fish, however, juveniles have been seen to nurse for as long as 2-2½ years in addition to eating fish and appear to do so until separated from the mother.

Results and Discussion

Calving dates for the 13 breeding females (California and Florida) used in Sea World's breeding program since 1978 are shown in Table 1 and include three calves born to two of the females prior to this time. One of the females has had four calves since 1973, the most recent calf born in 1981. Another female has had three calves, six have had two calves and another five have each had one calf to-date. Several of these females are currently pregnant.

Monthly calving activity for the breeding colonies in Florida and San Diego is summarized in Fig. 2. In Florida, where the male and females remain together year-round, calving occurs throughout the year. Serum testorsterone levels in the male in this colony are illustrated in Fig. 3 for an 18 month period. Over this time, three females had calves and two became pregnant. Preliminary conclusions from the data suggest that the two peaks in testosterone (8/1978 and 2/1979) are associated with impregnation of two females, one of whom had a calf 8/1979 and the other a premature stillbirth 4/1980. With the exception of one very low period and the high peak activity, this breeding male's testosterone levels generally ranged from 2-6 ng/ml. These levels were always significantly higher than those of an immature male which ranged from .01-.09 ng/ml, never exceeding .1 ng/ml for the same 18 month period.

In the San Diego breeding group where pregnant females are removed to nursery pools and remain there until their calves are about one year of age, calving generally occurs from March-May and from September-November with peak activity in April-May and October. Given the year-round calving activity in the Florida program, it is presumed that the clustering of calving activity in the San Diego colony reflects the husbandry schedule followed in that program. Calving intervals in the Florida colony generally range from 21-31 months (ave., 25 months). With the current program in San Diego, calving intervals are somewhat longer ranging from 23-41 months (ave., 34 months).

Current research efforts are being directed towards; 1) the monitoring of reproductive hormones in females and males in these colonies in order to contribute baseline data needed to resolve such issues as length of gestation in females and reproductive competence in males, 2) the development of chromosomal and protein electrophoretic markers to verify paternity (D.A. Duffield, Portland State Univ.), and 3) the definition of the ontogeny of various behaviors in Tursiops (P. Yokum, Hubbs-Sea World Research Institute).

With the continued maintenance of productive breeding groups of Tursiops at Sea World, it is hoped that aspects of the reproductive biology of this species which are difficult to examine in the field can be further compared and defined. Our thanks must go to the Sea World staff whose dedicated efforts have so largely contributed to the on-going success of this breeding program.

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Table 1: Calving dates for breeding females in the San Diego and Florida colonies.

SWF	F1.	5/78		4/80[sb]		1/82	
	F2.		5/79		6/81		
	F3.				7/81		
	F4.		2/79		9/81		
	F5		8/79		10/81		

SWC	F1.			5/76	4/78		4/81
	F2.					10/79	
	F3.					10/80	
	F4.					5/80	
	F5.				10/78[sb]	11/80	
	F6.	5/73	4/75		9/78		3/81
	F7.				5/78		4/81
	F8.				5/78		4/81

[sb] Stillbirth

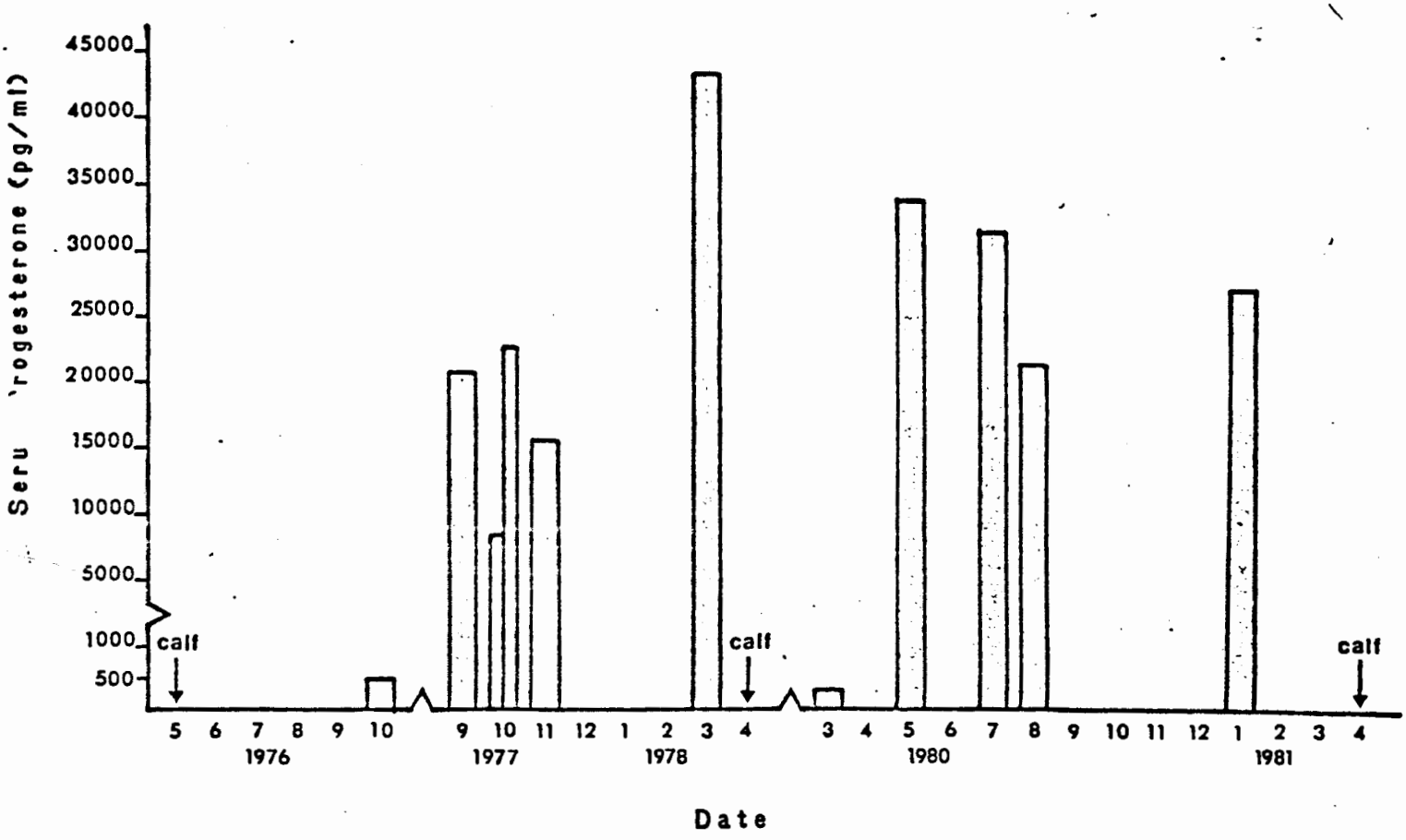

Fig. 1. Changes in serum progesterone with pregnancy. This female has had three calves from 1976-1981.

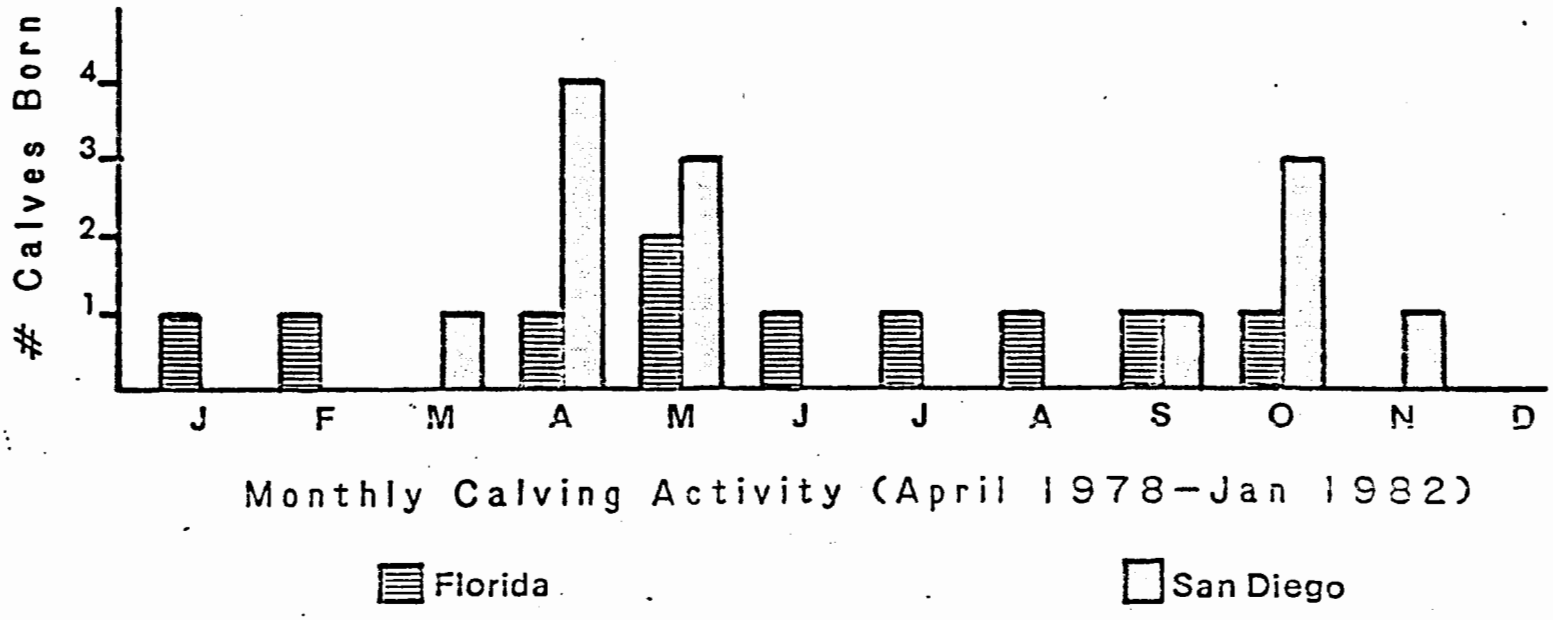

Fig. 2. Monthly calving activity for the Florida and San Diego breeding colonies. In the Florida colony, calving is distributed throughout the year. The San Diego colony is under a different husbandry schedule and calving peaks in the spring and fall months.

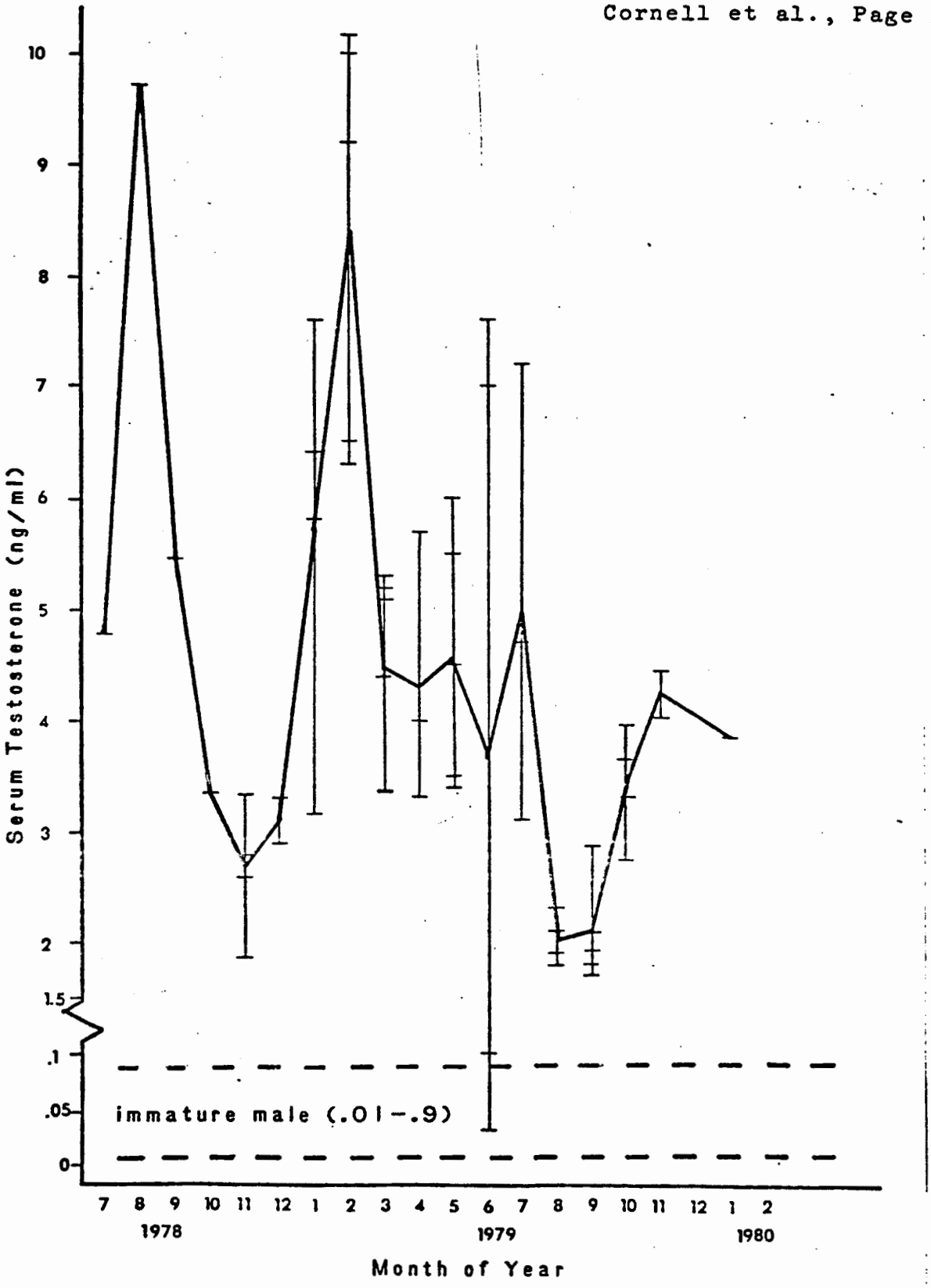

Fig. 3. Serum testosterone for an 18-month period in the Florida colony breeding male, compared with an immature male. The crossbars represent individual data points per month, the line connects monthly averages.

SEA WORLD TURSIOPS BREEDING PROGRAM
1978 to Oct. 1982

	Live Born	Still Born	Died	Alive	Success Rate	Sex M	Sex F	Yet Undetermined
FLA.	9	1	3	6	66%	5	2	2
S.D.	15	1	2	13	87%	8	4	3
TOTAL	24	2	5	19	79%	13	6	5

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
No.Born	1	1	1	5	5	1	1	2	2	6	1	0
Percent of Total	4%	4%	4%	19%	19%	4%	4%	8%	8%	23%	4%	0

Year	1978	1979	1980	1981	1982
No.Born	6	4	4	8	4